REMARKS:

1) Referring to item 10) of the Office Action Summary, please indicate the acceptance of the drawings filed on December 12, 2005.

2) The Examiner's attention is directed to the enclosed Information Disclosure Statement formally citing the reference that was originally cited in the specification at page 7 line 17. Please consider the reference and return an initialed, signed and dated acknowledgment copy of the IDS Form PTO-1449 of February 1, 2008.

3) In accordance with the PCT procedures, the original specification of this application was a direct English translation of the foreign-language PCT International Application text. The specification has now been editorially amended for clerical and editorial improvement and clarification. The amendments are supported by the substance and the context of the original disclosure, and do not introduce any new matter. Entry thereof is respectfully requested.

4) The claims have been amended as follows. Claim 2 has been amended to correct "S" to --Si--. Claim 4 has been limited by deleting B and Cr from the possible addition elements. Claim 5 has been limited by requiring a positive content of V. Claim 8 has been amended for clarification of the "WC-based cemented carbide" as referring to a --cemented carbide comprising WC--. Claims 12 to 18 have been added to recite additional features of

the invention disclosed in the original written description at page 19 line 18 to page 20 line 2, page 20 lines 22 to 27, and page 22 Table 2. Thus, the claim amendments and the new claims do not introduce any new matter. Entry and consideration thereof are respectfully requested.

5) Referring to section 2 on page 2 of the Office Action, the recitation of "S" in claim 2 was an inadvertent error that has now been corrected to --Si--. Claim 2 is now consistent with claim 1 and the written description. Accordingly, please withdraw the indefiniteness rejection of claim 2 under 35 USC 112(2).

6) Referring to section 3 on page 2 of the Office Action, the intended meaning of "WC-based cemented carbide" has been clarified to refer to a --cemented carbide comprising WC--. Claim 8 is now definite because it particularly points out and distinctly claims the subject matter of the invention. Please withdraw the rejection of claim 8 under 35 USC 112(2).

7) Referring to section 4 on pages 2 and 3 of the Office Action, the assertion that "*claim 9 recites the broad recitation types of tools, and the claim also recites particular inserts which is the narrower statement of the range/limitation*" is respectfully traversed. Claim 9 does not recite a broad range or limitation together with a narrower range or limitation. Instead, claim 9 clearly recites a list or group of different cutting tools. Namely, the cutting tool may be any tool selected from the group

of cutting tools consisting of drills, end mills, cutting edge-replaceable inserts for milling, cutting edge-replaceable inserts for turning, metal saws, gear cutting tools, reamers, and taps. These are all different types of cutting tools, and the claimed invention may be any one of these cutting tools. There is no optional recitation of a narrower range or limitation that falls within the broad range or limitation. There is simply a single list of cutting tools from which the inventive surface-coated cutting tool may be selected. Accordingly, please withdraw the objection to or rejection of claim 9 in this regard.

8) Before specifically addressing the prior art rejections and comparing the claimed features of the invention to the prior art disclosures, the invention will first be discussed in general terms to provide a background.

The present invention is directed to a surface-coated cutting tool comprising a coating film disposed on a base. The coating film comprises a hard layer with a particular recited composition, thickness, and hardness. Furthermore, the hard layer must have a particular recited elastic recovery index value defined according to the invention as (hmax - hf)/hmax, which must be at least 0.2 and not more than 0.7. In the elastic recovery index defined according to the invention, namely (hmax - hf)/hmax, the term "hmax" represents the maximum indentation depth of an indenter into the hard layer, and the term "hf" represents the indentation depth remaining after unloading and retracting the indenter in a hardness test carried out by nano-indentation.

The specific measure or definition of elastic recovery according to the invention is based on the elastic recovery of the coating film obtained from the difference (hmax - hf) between the maximum indentation depth (hmax) and the dent depth (hf) remaining after unloading in a nano-indentation test. This difference (hmax - hf) is then normalized by dividing it by the maximum indentation depth (hmax) to produce the elastic recovery index value (hmax - hf)/hmax that is of interest in the present invention. Thus, this elastic recovery index represents the difference between the maximum indentation depth and the dent depth remaining after unloading (which indicates the amount of elastic recovery), as a proportion or fraction of the maximum indentation depth. In this regard, see the present specification at page 6 line 27 to page 7 line 3, page 8 lines 9 to 28.

Also see Figs. 4 and 5 of the present drawings, representing an indenter (30) being pressed into a coating film (20) to form an indentation. Fig. 5 shows the process of applying an indentation load (P) to the indenter, beginning from 0 load up to the maximum indentation load (Pmax) and then unloading or removing the load from Pmax back down to 0 load and retracting the indenter. When applying the maximum load Pmax, the indenter penetrates or indents the coating film up to the maximum indentation depth (hmax). Then, after unloading and retracting the indenter, an indentation remains, but the remaining indentation no longer has the same maximum indentation depth (hmax), but rather due to the elastic recovery of the material of the coating film, the indentation depth after unloading has been reduced to a smaller value (hf) that depends on the degree

of elastic recovery of the material. The degree of elastic recovery is given by the difference (hmax - hf) as can be seen in the legend of Fig. 5. Thus, the inventive elastic recovery index (hmax - hf)/hmax indicates the degree of elastic recovery as a proportion or fraction of the maximum indentation depth.

As also discussed in the specification, the inventors have found that this elastic recovery index is an important indicator of a quality of the coating film for achieving excellent fracture resistance and chipping resistance (page 5 lines 3 to 6, page 6 line 4 to page 7 line 3, page 8 lines 9 to 28 and page 25 lines 1 to 10).

Furthermore, the inventors found that not only the material composition, but also the fabrication and processing technique, have a significant influence on the resulting elastic recovery index. Particularly, in Tables 1 and 2 on pages 21 and 22 of the specification, samples 1 to 32 were prepared in such a manner so as to achieve the inventive elastic recovery index values, and samples 51 and 52 were prepared with a conventional preparation step that fails to produce the inventive elastic recovery index values. Namely, the samples 1 to 32 involved a base of cemented carbide mounted on a water coolable base holder, then a film forming process was carried out to deposit the desired coating film on the base in a reaction chamber, and then the film forming process was stopped and **helium (He) gas** was introduced to fill up the chamber while the base holder was cooled by **water-cooling** so as to **quench** the sample. On the other hand, the samples 51 and 52 were processed with an ordinary conventional annealing step instead of the special inventive process using He gas

filling up the chamber and quenching the sample by water-cooling the base holder. Thus, it was found that <u>the **special process technique** of **introducing He gas** to the chamber and **quenching the sample by water-cooling** the base holder was critical for achieving the inventive elastic recovery index values</u> (see page 19 line 25 to page 20 line 2 and Tables 1 and 2 on page 21 and 22). As a particular example, compare sample 1 with sample 52, whereby samples 1 and 52 both have a similar film type or composition and similar thickness of the hard layer, the same reaction gas, and a similar intermediate layer. The main difference is that sample 1 was processed with the inventive He gas introduced into the chamber and quenching by water-cooling at the end of the film forming process, but sample 52 was prepared with a conventional annealing step at the end of the film forming process. As a result, sample 1 has a high elastic recovery index value of 0.45, but sample 52 has a low value of 0.10. More generally, it can be seen that all of the samples 1 to 32 produced with the inventive helium gas introduction and quenching step at the end of the film-forming process have the inventive high elastic recovery index values, while both of the samples 51 and 52 produced with a conventional annealing step at the end of the film forming process have low elastic recovery index values below the inventive range. Thus, the invention has shown that <u>the **processing conditions** (and not only the hard layer composition) are critical for achieving the inventive elastic recovery index values</u>. In other words, samples meeting all of the other requirements of present claim 1 <u>**do NOT** necessarily and **inherently** have the inventive required elastic recovery index</u>

<u>values set forth in claim 1, depending on the processing conditions</u>.

Also, Table 4 shows that the samples 1 to 32 achieved good results in both a continuous cutting test and an interrupted cutting test (see Table 3 on page 23 and Table 4 on page 24), while samples 51 and 52 did not achieve good results, and particularly were fractured or chipped (also see page 25 lines 8 to 10). Thus, the invention has also shown that the elastic recovery index value according to the invention has a significant impact on the cutting performance of the cutting tool.

The prior art does not disclose and would not have suggested the presently claimed elastic recovery index value range or how to achieve it.

9) Referring to sections 5 to 10 on pages 3 to 5 of the Office Action, applicant respectfully traverses all of the prior art rejections of claims 1 to 11 respectively as anticipated by any one of US Patent 7,166,155 (Ishikawa '155), or US Patent 6,824,601 (Yamamoto et al. '601), or US Patent 6,767,658 (Yamamoto et al. '658), or US Patent 6,586,122 (Ishikawa et al. '122), or JP 2002-337007, or JP 2000-326108, or JP 11-131216, or JP 09-295204, or JP 08-120445, or US Patent 5,580,653 (Tanaka et al. '653).

In each of the rejections, the Examiner has asserted that the references disclose the claimed coating with the claimed composition on the claimed substrate within the claimed thickness made by the claimed method used for the claimed tools, <u>so that therefore the claimed hardness and the **elastic recovery index**</u>

<u>**(hmax - hf)/hmax values** are considered to be **inherent**</u>. These assertions are respectfully traversed, especially regarding the method used for making the coating film and the asserted inherency of the elastic recovery index values.

Contrary to the Examiner's assertion, <u>all of the applied references do **NOT** disclose the elastic recovery index (hmax - hf)/hmax must be at least 0.2 and not more than 0.7</u>, as according to the present invention defined in present claim 1.

For example, it is noted that Ishikawa '155 discloses an "elastic recovery ratio E" but that is significantly different from the inventive elastic recovery index (hmax - hf)/hmax. Namely, the elastic recovery ratio E of Ishikawa '155 is defined as 100 - ((contact depth)/(maximum displacement at maximum load)) as set forth in col. 3 lines 2 to 8. The contact depth and the maximum displacement at maximum load are to be determined by nano-indentation according to the cited article of W. C. Oliverand et al., J. Mater Res., Vol. 7, No. 6, June 1992, pp. 1564-1583. Furthermore, it seems that the just-cited article of W. C. Oliverand et al. quotes Fig. 2 of the article identified as "Tribologist" at page 7 line 17 of the present specification and enclosed with the IDS being filed with this Response. The contact depth is represented by the term (hc) in Fig. 2 of the "Tribologist" article. That contact depth (hc) represents the depth of the coating film when plunging the nano-indenter into the coating film namely the depth of the indentation formed by the indenter while the indenter is plunged into the surface of the coating film by nano-indentation, taking into account the elastic depression of the surrounding surface of the coating

film. The maximum displacement at maximum load indicates the maximum distance that the indenter travels while indenting into the coating film, for example like a maximum indentation depth. Thus, <u>the significant factor of the elastic recovery value ratio E of Ishikawa '155 is the ratio or proportion of the contact depth (hc) **during indentation** to the maximum displacement at maximum load of the indenter **during indentation**</u>. Both measurements are measurements during the indentation. On the other hand, <u>the invention specifies the amount of **elastic recovery** in view of the **dent depth remaining after the indenter is unloaded and retracted**</u>. Ishikawa '155 does not use such a remaining unloaded dent depth.

More particularly, the invention defines the difference between the maximum indentation depth at maximum load (hmax) and the remaining dent depth after unloading (hf) to determine the degree of elastic recovery, and then forms the ratio or normalized index of this elastic recovery relative to the maximum indentation depth. This provides significantly different information compared to the ratio E of Ishikawa '155, which is only based on measurements taken during the indentation, and does not involve a measurement of the remaining dent depth (hf) after unloading and retracting the indenter. Thus, Ishikawa '155 does not disclose the present elastic recovery index or the particular limited range of values thereof as set forth in present claim 1.

Also, due to the significantly different meaning of the ratio E according to Ishikawa '155, a person of ordinary skill in the art would have found no suggestion toward the presently claimed different elastic recovery index, and also would have had

no teaching of a pertinent value range for such an elastic recovery index to achieve good cutting tool characteristics as demonstrated by the present invention.

The Examiner has not pointed out any prior art disclosure of an elastic recovery index and a pertinent value range as presently claimed, in any of the applied references. Contrary thereto, it is respectfully submitted that all of the applied references do not disclose the elastic recovery index (hmax - hf)/hmax is at least 0.2 and not more than 0.7, as according to the present invention.

Furthermore, <u>the Examiner's assertion of **inherency** is traversed and has been overcome by factual evidence discussed above</u>. Namely, the test results of samples 1 to 32 compared to samples 51 and 52 in Tables 1, 2, 3 and 4 on pages 21, 22, 23 and 24 of the present specification, demonstrate that <u>the processing technique and conditions are critical for achieving the inventive elastic recovery index values</u>. Namely, samples having a composition and thickness of the hard layer falling within the present claims can nonetheless have an elastic recovery index value falling outside of the presently claimed range, due to fabrication with a conventional production technique. Particularly, <u>samples 51 and 52 were conventionally **annealed**</u> at the end of the film-forming process, while on the other hand samples 1 to 32 had <u>**helium** (He) gas introduced into the processing chamber and were **quenched** by water-cooling</u> the base holder at the end of the film forming process.

The Examiner has asserted that the same production methods are used in the prior art, but the Examiner has not pointed out

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anywhere in the references disclosing such a helium gas flush and quenching of the sample by water-cooling the base holder. It is noted that Yamamoto et al. '610 disclose the use of a noble gas such as argon in the processing chamber (col. 3 lines 12 to 18, col. 13 lines 43 to 46). Particularly the use of helium does not seem to be disclosed by Yamamoto et al. '601. More importantly, Yamamoto et al. '601 do not seem to disclose or suggest <u>quenching the sample by water-cooling the base holder</u> at the end of the film forming process. Thus, Yamamoto et al. '601 apparently uses conventional processing such as with an annealing step after the film formation. Based on the comparison of samples 51 and 52 with samples 1 to 32 as set forth in Tables 1 to 4 of the present specification, it <u>must be expected that the samples of Yamamoto et al. '601 have elastic recovery index values falling outside of the presently claimed range</u>.

Thus, the particular test data reported in Tables 1 to 4 of the present application overcomes the Examiner's unsupported assertion of inherency of the elastic recovery index values.

For the above reasons, the Examiner is respectfully requested to withdraw all of the anticipation rejections of the respective claims 1 to 11.

10) The new claims 12 to 18 recite additional features that further distinguish the invention over the prior art. The Examiner is respectfully requested to consider these new dependent claims in comparison to the disclosures of the prior art references. Claim 18 is a product-by-process claim that expressly requires the cutting tool of claim 1 to have such characteristics as result

from fabricating the tool with a production process involving filling helium gas into the reaction chamber at the end of the film-forming process and quenching by water-cooling the base holder. The above discussion demonstrates that these product-by-process features do actually have an influence on the resulting product, and therefore such product-by-process features must be considered when evaluating the patentability of the product itself.

11) Favorable reconsideration and allowance of the application, including all present claims 1 to 18, are respectfully requested.

Respectfully submitted,
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Enclosures:
Transmittal Cover Sheet
IDS, Form PTO-1449, 1 reference
Term Extension Request
Form PTO-2038

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